PREFACE

By
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Chairman of
the Central Training Council

In July 1968, the Central Training Council issued a message to managers on the national impact of computers, expressing concern that the potential benefits to the nation in improved efficiency, productivity and method should not be impaired by a failure to meet the expected growth in demand for further education and training of computer staff.

The Council set down in its Memorandum No. 7 a procedure agreed between the Department of Employment and Productivity and Industrial Training Boards for the setting up of joint committees of Boards to co-ordinate the preparation of training recommendations for occupations which are found in more than one industry.

In accordance with this procedure, the Engineering Industry Training Board was requested by the Department to broaden the membership of its Computer Training Policy Committee to embrace the interests of other Boards for the purpose of drawing up training requirements for computer staff which would apply generally to all industry and commerce.

This Committee began its work in December 1967 and Working Parties were given the priority tasks of drawing up recommendations for increasing management appreciation of computer use, and for the training of systems analysts. I would like to take this opportunity on behalf of the Council of commending the EITB and the Committee on the speed and thoroughness with which their first assignments have been completed.

The Council proposes to give publicity to the reports of joint committees which have a widespread interest, not only for training boards but for other organisations. This booklet represents, therefore, the first in this new series, and deals with the training of systems analysts (commercial).

I believe that these publications will be of value to a wide range of commercial, industrial and educational establishments in co-ordinating the recommendations of individual training boards and in setting national standards for key personnel in occupations common to a number of industries and services.

Contributions to the training of computer staff can be made by universities and colleges, manufacturers and users and the training boards themselves, and the Council commends this Report as a matter of national importance to all who are concerned with the training of systems analysts.

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I INTRODUCTION

1 This booklet is concerned with the training of systems analysts to the stage at which they are appointed to their first post of responsibility, and is written for the attention of managers and training officers who are responsible for their training.

2 A systems analyst may be defined as a person who is able to apply his knowledge of computer applications to the investigation and solution of problems. Under the guidance of management he identifies what needs to be achieved, determines how the required results can be obtained, selects the appropriate methods and plans the implementation of the system designed to meet the objectives.

The range of activity of such people is very broad but it is possible to identify three main groupings. First there are those whose work is centred upon the problems of manufacturing processes such as computer controlled machining. Second there is a group who are primarily concerned with the analysis of scientific and technological problems and their computer aided solutions. A third grouping comprises analysts whose tasks are related to the study and design of systems for use in administration, management control and business operations.

3 The training recommendations which are described in this booklet refer to this third group which is the largest, and the title "systems analysts (commercial)" is used for ease of reference throughout the text.

Systems analysts will continue to learn throughout their careers and further training requirements are likely to arise, for example due to development in computer techniques, but these are not dealt with here.

4 It is the responsibility of senior management to direct the work of systems analysts (commercial) and to select the systems which are to be implemented. It is important therefore that they accept their responsibilities in the training of such people.

II BACKGROUND TO THE TRAINING RECOMMENDATIONS

5 In 1967 a report was published of an interdepartmental working group* entitled "Computer Education". The report considered the steps which the education service needed to take to improve the supply of trained people working with computers in view of an estimated three-fold increase in the number of computers in use by 1970. Five categories of computer staff were identified, namely advanced programmers, systems analysts, programmers, operators and maintenance people. One of the major conclusions of the report was that the most critical shortage of trained staff lay in the group engaged on systems analysis.

6 This conclusion was endorsed by the Computer Training Policy Committee which the EITB set up in December 1967 at the request of the Department of Employment and Productivity as a Joint Committee representing a number of training boards, for the purpose of co-ordinating the preparation of recommendations for occupations found in more than one industry. A high priority was therefore given to an examination of the training requirements of systems analysts (commercial).

III BASIS OF THE TRAINING RECOMMENDATIONS

7 The job of a systems analyst (commercial) has been studied in detail over a range of computer users and a job specification agreed by a wide cross-section of organisations including computer manufacturers. The specification is given in Appendix 1 and contains the skill and knowledge requirements from which the training recommendations have been derived.

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* Department of Education and Science,
Scottish Education Department,
Ministry of Education for Northern Ireland.
HMSO publication.

8 It is not intended that the job specification should be regarded as a rigid description of the job of a systems analyst (commercial) for all to follow. The job specification is presented as a guide and it is expected that firms will need to modify certain parts in order to bring the job content into line with the requirements of their particular organisational structure and practice. Any changes to the specification are likely to involve changes in the skill and knowledge requirements of the trainee and firms will need to examine this effect upon the derived training programme.

IV THE TRAINING RECOMMENDATIONS

9 A study of the job skill and knowledge requirements indicates that the training of a systems analyst (commercial) can be conveniently divided into three stages, that is:

Stage One: **Business Training.**
Stage Two: **Computing Training.**
Stage Three: **Systems Analyst Training.**

10 The recommended training content for these stages is now described. It has been concluded that each stage can best be arranged in two parts, that is an off-the-job course followed by a period of planned on-the-job practical experience.

The purpose of the off-the-job training at the beginning of each stage is to provide the trainee with a sound foundation of knowledge which will enable him to obtain the maximum benefit from his on-the-job training. The latter is itself needed to develop skill, to consolidate the trainee's knowledge and to relate it to the practice in his firm.

(A) STAGE ONE: BUSINESS TRAINING

The objectives of this part of the training are to give the trainee an understanding of:

(a) The purpose and inter-relationships of the main functions within an organisation.

(b) The problem of introducing computer based systems to industrial concerns.

Part One: Off-the-Job Training

A course of not less than two weeks is recommended, dealing with a general introduction to business operations. A guide syllabus is given in Appendix 2a.

Part Two: On-the-Job Planned Experience

The main activities in which experience is required are likely to include accountancy, purchasing, sales, manufacturing and engineering design. It is suggested that a trainee should be attached to appropriate departments within his firm, primarily in order to study their particular systems of operation and the ways in which their work is interdependent.

Experience has shown that training based on a series of attachments to a number of departments requires a high degree of co-ordination and control by the person responsible for the training as well as close co-operation from departmental heads. To assist in this work a training programme guide is given in Appendix 2b which contains terminal performance standards linked to each element of the training specification together with a number of training examples.

It is likely that for a trainee with no previous similar experience such a programme of training will take a minimum of six months to complete.

(B) STAGE TWO: COMPUTING TRAINING

The objectives of this stage of the overall training are to give the trainee an understanding of:

(a) Computer Hardware.
(b) Computer Software.
(c) Data Collection and Data Preparation.
(d) The organisation of computing and data processing departments.

The aim is to help the trainee to become aware of the potential of modern computers and to appreciate the problems of computer applications.

Part One: Off-the-Job Training

A suitable syllabus for this initial training is shown in Appendix 3a. Such a course is estimated to require two weeks and a number already operate in colleges, computer manufacturer's and user organisations.

Part Two: On-the-Job Training

This training should take place in the main computing and data processing departments of the trainee's firm. A training programme guide is given in Appendix 3b. It is expected that firms will need to emphasise those parts of the programme which relate especially to their particular computer installation and organisation. An appropriate period for this training is approximately three months.

(C) STAGE THREE: SYSTEMS ANALYST TRAINING

In this final stage of training, the objectives are to equip the trainee with:-

(a) A working knowledge of the practice of systems analysis.
(b) The job skills and knowledge additional to those dealt with in Stages One and Two, which he requires to perform satisfactorily in his first post of responsibility.

Part One: Off-the-Job Training

A minimum course length of four weeks is recommended and a guide to its content is given in Appendix 4a. Fact finding, recording and analysis, system design, implementation and operation are the principal matters in such a course.

Part Two: On-the-Job Training

At the end of this training, the trainee is to be appointed to his first post of responsibility as a systems analyst (commercial). It is therefore important that he is assigned tasks of increasing responsibility and of a kind which enable him to acquire confidence. Such training will consist mainly of project work and the principal areas of activity are likely to include:

(a) Fact finding, recording and analysis.
(b) Developing computer based systems.
(c) Implementing computer based systems.

Several examples of suitable projects are shown in Appendix 4b, but it is desirable to involve the trainee in real work problems when ever possible. The time allocated to this training will usually be about six months. In practice, however, because of the nature of the work being carried out in a firm, the training may need to be spread over a longer period.

V TRAINING ARRANGEMENTS

11 The previous education and industrial experience of the trainee will need to be taken into account in determining the most appropriate training arrangement. For example, candidates for systems analyst (commercial) jobs are usually either graduates straight from university, programmers of about two years experience or existing administrative or technical staff such as accountants and technologists; the training programme for each of these groups is likely to take the following form:

OVERALL TRAINING PROGRAMME

TYPE OF TRAINEE	STAGE 1 Business Training		STAGE 2 Computing Training		STAGE 3 Systems Analyst Training		
	Off-the-job course	Planned on-the-job experience	Off-the-job course	Planned on-the-job experience	Off-the-job course	Planned on-the-job experience	
1. Graduates (No previous industrial experience)	2 weeks	24 weeks	2 weeks	12 weeks	4 weeks	24 weeks	Total 68 weeks
2. Programmers (2 years experience of computer programming)	2 weeks	24 weeks			4 weeks	24 weeks	Total 54 weeks
3. Existing Administrative and Technically Qualified Personnel (Previous Industrial training or 2/3 years experience)			2 weeks	12 weeks	4 weeks	24 weeks	Total 42 weeks

12 The individual ability of trainees and the emphasis which firms may wish to place on certain elements in the overall training programme are further factors which may call for modification to the training proposals as illustrated in this booklet. It is for firms to adapt the recommendations within the given guide lines so that they suit their particular requirements.

VI SELECTION

13 The job specification for a systems analyst (commercial) lists a wide range of skill and knowledge that he needs to possess. In addition a successful analyst requires integrity, stamina, tact and persistence to overcome difficulties, and perhaps above all a large fund of common sense. It is important that every effort should be made at the selection stage to identify trainees with the potential to develop the necessary abilities.

This is a difficult task and as yet there is insufficient evidence of successful methods which can be put forward as a reliable guide.

14 A valuable aid to improving initial selection methods can be developed through systematic assessment of trainees' progress. Regular appraisal of a trainee's performance should be made against the standards set down in the training programme. The results of such appraisals can build up evidence which will enable the entry standard requirements of trainees to be more closely defined.

15 All reports on the supply of systems analysts have pointed to the serious short-fall that is likely to occur because of the rapid increase in the use of computers unless steps are taken to deal with it. All existing and intending computer users are urged to examine their requirements for people at this level and take steps to select and release suitable candidates for training.

VII TRAINING REQUIREMENTS

16 It is suggested that Industrial Training Boards could award grant for systems analyst (commercial) training on the lines indicated herein. The criteria for grant could thus provide for training, as appropriate, of:

(a) Business training.

(b) Computing training.

(c) Systems Analyst training.

Written training programmes should exist based on the analysis of the job of a systems analyst (commercial) and programmes based on those given in this booklet, modified as necessary, should prove acceptable.

Records of training conducted should be maintained.

APPENDIX 1

Job Specification for a Systems Analyst (Commercial)

JOB DESCRIPTION	TASK ELEMENTS	KNOWLEDGE	SKILL
1. Fact finding, Recording and Analysis	1.1. Find out the objectives of the activity to be analysed and confirm findings with management. 1.2. Interview key staff and prepare a plan of action. 1.3. Find and check: (a) The organisation of the area concerned. (b) The policy on the system to be designed. (c) Information flow. (d) The procedures in current use. (e) Volumes and frequencies of information. (f) All documentation in use, obtaining copies. (g) The audit and legal requirements. 1.4. Obtain management confirmation that the facts in 1.3 above, accurately reflect the situation and that there are no omissions. 1.5. Document the facts recorded in accordance with established standards.	The organisation of the area concerned. The span of responsibilities of the departmental managers concerned. The consequences of decisions. Business/Commercial Industrial background. Communication methods. Basic office systems and procedures including:- (a) Manual Systems. (b) Accounting Machine Systems. (c) Unit Record Systems. Basic office organisation. Systems standards.	Human relations including interviewing techniques. Data gathering and recording techniques. Data organisation and analysis. Organisation and methods techniques including: (a) Work sampling. (b) Flowcharting. (c) Documenting. (d) Procedure records. Evaluation and Design of forms. Self-Management.
2. Design alternative systems and select optimum system	2.1. Establish the feasibility of computer based systems in the area under consideration. 2.2. Outline alternative computer based systems, collecting additional information where necessary and consulting appropriate specialists.	Balancing the costs of developing and operating Data Processing Systems against management objectives and operational requirements.	Techniques for costing the development and operation of modern computer based systems. Making the best use of available hardware and software.

APPENDIX 1

Job Specification for a Systems Analyst (Commercial)

JOB DESCRIPTION	TASK ELEMENTS	KNOWLEDGE	SKILL
	2.3. Select the optimum system. 2.4. Obtain management approval for the development of the new system. 2.5. Design the selected system. 2.6. Obtain management approval for the implementation and operation of the new system.	The capabilities and limitations of varying configuration of computer systems and an awareness of future developments Principles of good systems design. The capabilities and limitations of personnel involved in Data Processing Systems. Appreciation of Modern Management Techniques. Audit and legal requirements. Communication methods.	Forecasting resources required and establishing time scales. Report writing and case presentation. Block diagramming.
3. Develop, implement, operate and maintain the system.	3.1. Present to, and discuss with the user department the new system. 3.2. Prepare detail plan for implementation. 3.3. Prepare program specification. 3.4. Write job procedures for user department. 3.5. Write job procedures for data preparation and computer departments. 3.6. Arrange for program and system testing. 3.7. Specify training of staff in user departments. 3.8. Arrange for customer and volume testing. 3.9. Maintain and monitor the system.	Programming strategy. Systems and programming standards. Communication methods. Systems procedures. Data preparation and computer organisation. Possible error conditions. Basic principles of computer education and training. Planning and monitoring of computer based systems.	Writing program specifications. Report writing and case presentation. Procedure writing. Planning flow of work through Data Processing Department. Control techniques.

APPENDIX 2a

STAGE ONE: BUSINESS TRAINING—PART 1 (OFF-THE-JOB COURSE)

(a) Introduction to the Course

(b) Organisation

1. Contemporary forms of ownership: Divorce of management from ownership: Contributory influences.
2. Enterprises and their markets—manufacturing.
3. Enterprises and their markets—financial and other services. (Similarities and differences in their functional aspects).
4. Organisation theory and practice
    - 4.1. Management structures.
    - 4.2. Effects of growth in size.
    - 4.3. Effects of complexity of work.
    - 4.4. Very large organisations.
    - 4.5. The typical functions of business, and their inter-relatedness
    - 4.6. Organisation and technology.
    - 4.7. Productivity of organisations.
5. The Organisation as a Network of Decision Centres linked by communications.

    The importance of decisions: The decision-making process: Data and decisions: The art of communications.
6. Analysis of Managers' functions i.e., definition of objectives, planning, organisation, work initiation and control.
7. Planning—importance, techniques, control and research.

(c) Sources of Management Information and Methods of Control

1. Financial accounting (general) methods and final accounts.
2. Costing methods, management accounting and budgetary control.
3. Project planning and control.
4. The auditing function.
5. Services available to management—i.e., accounting, work study, operational research, personnel, O & M, EDP and statistics.
6. Market research and sales promotion.
7. Production and material control procedures and documentation.
8. Sales accounting and invoicing procedures
9. Wages systems.
10. Stock control and purchasing.

(d) The Impact of Change

1. The need for change.
2. Individual and group attitudes.
3. Overcoming resistance to change and the importance of participation.
4. Training and education; its role in initiating and responding to change.

(e) Conclusion

The role of the Systems Analyst and his place in the organisation.

Summary:

Note: A business game will help to illustrate and support the lecture material.

BUSINESS TRAINING—PART 2 (ON-THE-JOB)

Department
MANUFACTURE

TERMINAL PERFORMANCE STANDARD	TRAINING SPECIFICATION	TRAINING EXAMPLES
The Trainee will understand:		
1. The production planning and control system used in his company.	1.1. Methods of deriving and implementing the company's overall production plan: (i) Programming. (ii) Scheduling. (iii) Inventory control. (iv) Detail planning. (v) Progress. (vi) Inspection.	The trainee will be attached to the Manufacturing Department, receive instruction and perform selected job tasks related to the training specifications. *Projects* 1. Prepare a chart showing the main channels of communication between the manufacturing and the ancillary departments, e.g., Quality Control, Planning, Stores.
2. The information channels between production and other departments.	2.1. Systems and procedures used for authorising, recording and instructing. 2.2. Information received by and sent to Finance, Sales and Purchasing Departments.	2. Determine what central information a superintendent of a selected "shop" requires to meet effectively his output objectives.
3. Processes utilised in the manufacture of the company's products.	3.1. The significant steps which feature in the manufacturing cycle, i.e., Jig and tool manufacture, assembly.	

BUSINESS TRAINING—PART 2 (ON-THE-JOB)

Department
DESIGN

TERMINAL PERFORMANCE STANDARD	TRAINING SPECIFICATION	TRAINING EXAMPLES
The Trainee will understand:		
4. The organisation and operation of the Design Department.	4.1. Systems and procedures used in department: (i) Instructing. (ii) Testing. (iii) Modifying. 4.2. Channels of communication with manufacture, purchasing and sales. 4.3. Time scales in development and design.	The trainee will be attached to the Design Department, receive instruction and perform selected job tasks related to the training specification. *Projects* 1. Examine and comment on the procedures for communicating modification requirements to products. 2. Report on the existing arrangements for the feed-back of information on the performance and reliability of products from customers and its relationship to design modifications.

Department
PURCHASING

TERMINAL PERFORMANCE STANDARD	TRAINING SPECIFICATION	TRAINING EXAMPLES
The Trainee will understand:		
1. The purchase order layout used in company.	1.1. Method of completion of order set; purchase order numbers, quantities, descriptions, prices, budget references, inspection requirements, delivery instructions.	The trainee will be attached to the Purchasing Department, receive instruction and perform selected job tasks related to the training specification.
	1.2. Methods of despatch of appropriate copies to user departments.	*Projects* 1. Investigate the range of information received by Purchasing Department and how it is used to determine orders.
	1.3. Order progress procedures.	
2. The goods received procedures used in company.	2.1. Method of recording goods received including inspection reports.	2. Compile report on input information from Purchasing Department to Computer Department.
	2.2. Method of passing information on goods received to production and accounts departments.	
3. The storekeeping procedures used in company.	3.1. Method of controlling issue of goods against stock requisitions.	
	3.2. Method of maintaining stock control records.	
	3.3. Methods of establishing, re-assessing and evaluating maximum and minimum stock holdings.	
4. The sub contracting procedures used by company.	4.1. Methods used to evaluate sub contracting needs.	
	4.2. Methods used to obtain and evaluate quotations.	
	4.3. Methods of control and payment of sub contractors.	

TRAINING PROGRAMME GUIDE—*continued*

BUSINESS TRAINING—PART 2 (ON-THE-JOB)

Department
SALES

TERMINAL PERFORMANCE STANDARD	TRAINING SPECIFICATION	TRAINING EXAMPLES
The Trainee will understand:		
1. The company's sales policies and procedures.	1.1. Methods of sales forecasting and programming: (i) Information received. (ii) Sources of information. 1.2. Methods of sales implementation. 1.3. Systems and procedures in use in sales office: (i) Pricing, cataloguing, costing. (ii) Changes in design, new design. (iii) Processing customer orders.	The trainee will be attached to the "Marketing" Department, receive instruction and perform selected job tasks related to the training specification. *Projects* 1. Prepare report on the control information needed by the manager of the sales department. 2. Examine the method of translating customer orders into despatch instructions, making recommendations on possible improvements to system.
Department **SERVICE & SPARES**		
2. The company's procedure in ensuring effective provision for customer service facilities.	2.1. Systems and procedures used to record and classify information from customers and service engineers. 2.2. Methods of determining spare part holdings. 2.3. Methods of dealing with warranty claims and customer complaints. 2.4. Systems and procedures in use in department. (Pricing, cataloguing, costing).	3. Examine and comment on the relation between forecast and actual warranty expenditure.

BUSINESS TRAINING—PART 2 (ON-THE-JOB)

Department
PERSONNEL

TERMINAL PERFORMANCE STANDARD	TRAINING SPECIFICATION	TRAINING EXAMPLES
The Trainee will understand:		
1. The Trade Union and allied procedures operating in company.	1.1. The methods of consultation and conciliation operating in company. 1.2. The Trade Unions or Workers' Association operating.	The trainee will be attached to the Personnel Department, receive instruction and perform selected job tasks related to the training specification.
2. The salary administration system used in company.	2.1. The wages and salary systems operating. 2.2. The staff grading system. 2.3. The company's methods of payment.	*Projects* 1. Prepare a report on the company's method of recruiting, selecting and training clerical personnel. 2. Report on the supervisory structure in a selected area of the company.
3. The records system maintained by company.	3.1. The types and methods of maintaining personnel records and statistics kept by company. 3.2. The use made by the company of these records.	
4. The manpower planning procedures used in company and how the requirements are met.	4.1. The method of establishing future manpower requirements. 4.2. The methods of recruitment and selection used by company. 4.3. The training schemes and facilities operated by company. 4.4. The company's methods of career development.	

BUSINESS TRAINING—PART 2 (ON-THE-JOB)

Department
FINANCIAL

TERMINAL PERFORMANCE STANDARD	TRAINING SPECIFICATION	TRAINING EXAMPLES
The Trainee will understand:		
1. The procedures involved on general ledgers.	1.1. Method of checking vouchers for payment of expense items. 1.2. Coding and classification of expense items. 1.3. The book-keeping system in use. 1.4. Method and frequency of balancing accounts. 1.5. Procedures for location of errors.	The Trainee will be attached to the Finance Department, receive instruction and perform selected job tasks related to the training specification. *Projects* 1. Assist in compiling a budget for a simple project. 2. Document the financial information contained in routine reports and outline the use made by management of this information.
2. The procedures involved on bought ledgers.	2.1. Method of checking and passing invoices for payment. 2.2. Method of affecting reconciliation with suppliers' statements. 2.3. Method of preparing accounts for payment. 2.4. Method of posting and balancing ledgers.	
3. The procedures involved on sales ledgers.	3.1. Method of raising, checking and passing customer invoices. 3.2. Method of posting and balancing ledgers. 3.3. Method of producing monthly statements and control of payments received. 3.4. Procedure for credit control.	
4. The methods of compiling periodic and annual accounts.	4.1. Methods and frequency of extraction of information. 4.2. Method of presentation of accounts.	

BUSINESS TRAINING—PART 2 (ON-THE-JOB)

Department
FINANCIAL

TERMINAL PERFORMANCE STANDARD	TRAINING SPECIFICATION	TRAINING EXAMPLES
The Trainee will understand:		
5. The procedure for analysing financial statements to assess profitability.	5.1. The use of financial ratios.	
6. The procedures involved in wages calculations.	6.1. Personal record system. 6.2. Procedures for calculating and paying wages.	
Department **COST**		
1. Cost allocation and control.	1.1. Methods of labour cost allocation and analysis. 1.2. Methods of coding and allocating materials costs. 1.3. Methods of collecting, allocating and absorption of overhead costs including service departments. 1.4. Methods of allocating fixed and variable costs.	
Department **INTERNAL AUDIT**		
2. Budgetary control.	2.1. Methods of compilation of budgets. 2.2. Methods for comparison of actual with budgeted results. 2.3. Methods for revision of budgets.	
3. The internal audit procedure used by company.	3.1. Method of preparation of audit program of work. 3.2. Procedures for reviewing book-keeping and internal control systems. 3.3. Methods used to establish reliability of records.	

STAGE TWO: COMPUTING TRAINING—PART 1 (OFF-THE-JOB COURSE)

APPENDIX 3a

(a) Introduction to the Course

(b) Basic Principles of Data Processing

1. Definition of Data Processing.
   What is data.
   Kinds of data.
   Handling data.
   Classification of data.
   Sorting.
   Calculating.
   Summarising.
   Recording.
   Communicating.

2. Range of Machines Processing Data.
   Relative speeds and capacities, charts, description and use of non-computer machines.

3. The Computer as an Aid to Data Processing.
   Work for which a computer may be suitable.

(c) Hardware

1. Data Representation (in coded form).
   Punched Cards.
   Punched Paper Tape.
   Magnetic Tape.
   Magnetic Discs.
   Magnetic Core.
   MICR.
   OCR Documents and Marked Sense Cards.
   Word Machines.
   Byte Machines.
   Character Machines.

2. Codes.
   Binary.
   Binary Coded Decimal.
   Octal.

3. Central Processor.
   Core.
   Boolean algebra.
   How decimal is converted into binary and vice versa by circuitry.
   Simple circuitry.
   Binary arithmetic.
   Arithmetic unit.
   Registers, accumulators, etc.
   Program control.

4 Limitations.
   Capacity.
   Costs.
   Developments.
   Compatibility.
   Flexibility.
   Speeds of peripherals and processors.

(d) Flowcharting and Programming

1. Idea of Program Flowcharting.
   Purpose.
   Basic Concepts.
   Use of Symbols.
   Sub-routine concepts.
   Loops (modification and counting).

2. Presentation of Flowcharting.
   Standards for working papers.
   Definite charts.

3. Development of Program Flowchart.
   System definition.
   Program specification.
   Outline flowchart.
   Supporting documents.
   Writing of detailed charts.

4. Flowcharting Development of Routine.
   Classification of routine.
   Optimisation.
   Design of routine.
   Problem identification.
   Techniques for effective sequences.
   Exceptions.

5. Machine Language.
   Use of numeric function codes.
   Allocation of computer storage to data and instructions.
   Word format for pure binary.
   Binary coded decimal, alpha numeric character notation and instruction.

6. Assembly Language.
   Assemblers.
   Use of mnemonic function codes.
   Data names and labels.
   Identification of program constants, input and output areas.
   Use of address modification, shift and logical functions.
   Packing and unpacking of data.
   Sub-routines.
   Transfer of data between central processor and peripherals.

7. High Level Language (COBOL).
   Compilers.
   Use of imperative statements, segmentation, paragraph headings and identifiers.
   Program structure, specification of data and problem solution.
   Selection of peripherals for data files.
   Use of internal labels on magnetic tape, planning of output print and punch.
   Relative costs of different language levels.
   Dependence of equipment.
   Future development and use of programming languages.
   Training implications.

8. Control and Service.
   Software—
   Executive and compiler routines.
   Utility packages.

9. Hardware Utilisation.
   Multi-programming.
   Simultaneity.

(e) Introduction to the Requirements of Systems Analysis

1. Feasibility Study.
   Initial investigation into the practicability of the introduction of an EDP system into a specific problem area.

2. Detailed Study.
   Full investigations into the existing system and preparation of an EDP system in detail; possibility resulting in the design and testing of a model system, costing and selection of a suitable configuration.

3. Implementation.
   Trials, conversion, evaluation, changeover to live running.

   Layout of core.
   Executive program.
   Registers.
   Input areas.
   Output areas.
   Work store.
   Constraints.
   Tables.
   Program.
   Channels.
   Control of peripherals.
   Links effected through control units.

4. Output Devices.
   Card Punch.
   Paper Tape Punch.
   Line Printer.
   Cathode Ray Tube Display Unit.
   Digital Increment Plotter.
   Interrogating Typewriter.
   Console Typewriter.

5. Input Devices.
   Card Reader.
   Paper Tape Reader.
   Conversion of data held in cards or paper tape into magnetic tape form by using a computer.
   Magnetic Ink Character Reader.
   Optical Reader.
   Interrogating Typewriter.
   Console.
   Processor-to-processor link (in same building—data exchange).
   Data communications with direct link to processor.
   Magnetic Tape preparation device.
   Kimball Tags.

6. Storage.
   Thin Film.
   Core.
   Disc (removable).
   Disc (non-removable).
   Drum.
   Magnetic Card file.
   Data Cell.
   Cram.
   Magnetic Tape.

7. Terminals and Controls.
   Telegraph Lines.
   Telephone Lines.
   Real-Time Links with Central Processor.
   Data Collection (on-line).

COMPUTING TRAINING—PART 2 (ON-THE-JOB)

Department
COMPUTER OPERATIONS

TERMINAL PERFORMANCE STANDARD	TRAINING SPECIFICATION	TRAINING EXAMPLES
The Trainee will:		
1. Understand the organisation of the operations section of the computer installation.	1.1. Methods of assembly of input prior to running. 1.2. Methods of distribution of computer output. 1.3. Organisation of file library. (i) Referencing system. (ii) Number of copies. (iii) Security of tapes or discs. 1.4. Safety precautions.	The trainee will be attached to the Computer Operations Department, receive instructions and perform selected job tasks related to the training specification. *Projects* 1. Prepare a job specification for a computer operator. 2. Investigate the effectiveness of a computer operating log book, commenting on the follow-up procedures on errors and comments.
2. Appreciate the computer operator's tasks and the equipment's capabilities.	2.1. Methods of loading input and output devices. 2.2. Controlling system from console. 2.3. Action on errors. 2.4. Housekeeping routines. 2.5. Back up facilities. 2.6. Diagnosis of error conditions.	
Department DATA PREPARATION		
The Trainee will understand:		
1. The organisation and operation of the data preparation function.	1.1. The methods of distribution and control of input documents to the data preparation staff. 1.2. The operation of punching, verifying and ancillary equipment. 1.3. The scheduling and control of work in the area.	The trainee will be attached to the Data Preparation and Planning and Control Departments, receive instruction and perform job tasks related to the training specification. *Projects* 1. Investigate the fluctuations in work load on data preparation departments.

COMPUTING TRAINING—PART 2 (ON-THE-JOB)

Department
PLANNING AND CONTROL

TERMINAL PERFORMANCE STANDARD	TRAINING SPECIFICATION	TRAINING EXAMPLES
2. The organisation and operation of the computer planning and control function.	2.1. The method of planning and scheduling work for the computer. 2.2. Methods of monitoring the through-put of the computer. 2.3. Methods of ensuring "cut off times" are met. 2.4. Methods of investigating delays in flow of work through computer.	2. Investigate the security of input information from user department to the computer.
Department **PROGRAMMING** **The Trainee will:**		
1. Understand how the programming function operates in his company.	1.1. The interpretation of program specifications. 1.2. Programming standards. 1.3. Flowcharting. 1.4. Documentation of programs. 1.5. The use of manufacturer's utilities and sub-routines. 1.6. The organisation of programming department.	The trainee will be attached to the Programming Department, receive instruction (programmed instruction texts are available) and perform selected job tasks related to the training specification. *Projects* 1. Write a simple program which can read input, up date file and print report. 2. Investigate and comment on the system of referencing used in the program library.
2. Be able to program competently in one programming language.	2.1. The techniques of programming in language specified by company.	

APPENDIX 4a

STAGE THREE:
SYSTEMS ANALYST TRAINING
PART 1 (OFF-THE-JOB COURSE)

(a) General

The systems analyst and his environment.
Communication methods.
Planning and monitoring.

(b) Fact Finding, Recording and Analysis

1. Fact Finding.
   Interviewing techniques.
   Data gathering techniques.
   O & M techniques.
2. Recording.
   System standards.
3. Analysis.
   Data organisation and analysis.

(c) Designing Alternative Systems and Selecting Optimum System

Principles of good system design.
Costing—
  Balancing costs and objectives.
  Costing development and operations.
Modern management techniques of use to the analyst.
Forecasting resources and organising staff.
Making optimum use of punch card equipment, computer hardware and software.
Block diagramming.

(d) Developing, Implementing, Operating and Maintaining System

System Controls and Auditing.
Programming strategy and standards.
Systems procedures and procedure writing.
Input and output media design.
Implementation and maintenance.
Education and Training.

APPENDIX 4b

SYSTEMS ANALYST TRAINING
PART 2 (ON-THE-JOB)

The trainee needs to be under the guidance of an experienced systems analyst and might usefully assist him in such projects as:

1. To plan and supervise the conversion of stock status records from an existing to a new format.
2. To design input and output documents on a new payroll system.
3. In conjunction with staff from user department prepare suitable test data.
4. Prepare a program specification for a new system.
5. Investigate and record the existing document flow in an area being studied.
6. To establish with staff from user departments reference data which can be used as a basis for monitoring the performance of a system.
7. To produce a program, indicating the resources—men, machines, and cost—required to design, develop, implement and operate a specific computer based system.

COMPUTER TRAINING POLICY COMMITTEE

Chairman: W. E. BUCKLEY
Head of Department of Mechanical and Production Engineering,
Blackburn College of Technology and Design

Members: J. C. C. ALLAN
Computer Education Manager, Rolls Royce Ltd.

G. W. BARRAS
Financial Director and Secretary, Arrow Electric Switches Ltd.

C. W. BLAXTER
Head of Methods and Education Division, Data Processing Group,
The National Computing Centre

Dr. W. BONNEY RUST
Principal, West London College

W. DAVIES
Principal Training Adviser, Iron and Steel Industry Training Board

W. A. DONALDSON
Senior Lecturer, Department of Industrial Administration, University of Strathclyde

F. S. ELLIS
Manager, Computer Engineering School, Elliot Automation Computers Ltd.

R. A. GRANTHAM
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SYSTEM ANALYST WORKING PARTY

Chairman: J. C. C. ALLAN
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National Computing Centre

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